UNITED STATES PATENT AND TRADEMARK OFFICE

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10/806,459	03/23/2004	Sergey Zhidkov	2557-000175/US	1227

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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

	Application No.	Applicant(s)
Office Action Summary	10/806,459	ZHIDKOV, SERGEY
	Examiner	Art Unit	
	Sonia J. King	2611	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE <u>3</u> MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.
- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on <u>07/08/2004</u>.

2a)☐ This action is **FINAL.**   2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) <u>1-48</u> is/are pending in the application.

    4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) <u>1-39 and 41-47</u> is/are rejected.

7)☒ Claim(s) <u>40</u> is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

    Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

    Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

    a)☒ All   b)☐ Some * c)☐ None of:

      1.☒ Certified copies of the priority documents have been received.

      2.☐ Certified copies of the priority documents have been received in Application No. _____.

      3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

    * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1)☒ Notice of References Cited (PTO-892)

2)☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3)☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date <u>See Continuation Sheet</u>.

4)☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

5)☐ Notice of Informal Patent Application

6)☐ Other: _____.

Continuation of Attachment(s) 3). Information Disclosure Statement(s) (PTO/SB/08), Paper No(s)/Mail Date :9/28/05,8/12/05,12/10/05,7/08/04.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1.   The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all

obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set
> forth in section 102 of this title, if the differences between the subject matter sought to be patented and
> the prior art are such that the subject matter as a whole would have been obvious at the time the
> invention was made to a person having ordinary skill in the art to which said subject matter pertains.
> Patentability shall not be negatived by the manner in which the invention was made.

2.   Claims 1- 20, 34 and 46 are rejected under 35 U.S.C. 103(a) as being

unpatentable over Arambepola US PG Publication 2003/0099287 A1 in view of Nielsen

US Patent 5692010.

3.   With respect to claim 1, Arambepola discloses a method of reducing noise in a

multiple carrier modulated (MCM) signal that has been equalized, the method

comprising: estimating (detecting impulsive noise in a stream of sets of samples in a

radio receiver and comparing a value base on an amplitude; paragraph 0004, 0005)

impulse noise (paragraph 0011). Arambepola also teaches, removing (blanking to zero)

a portion of the noise (paragraph 0003). Digital receivers are susceptible to various

forms of noise which can disrupt reception. Such receivers are particularly susceptible

to impulsive noise; impulsive noise comprises one or more discrete relatively high

amplitude pulses of relatively short duration and can disrupt reception to an

unacceptable extent. (paragraph 0002) It is known to perform impulse suppression by

zero substitution or "blanking to zero" of the data-carrying signal. If the noise impulses

can be detected, then the data can be blanked to zero so as to attempt to remove the

noise energy from the signal, for example supplied to the digital demodulator of the

receiver. In order to attempt to detect noise impulses, the absolute value of each digital

sample, following analog-to-digital conversion within the receiver, is compared with a

predetermined threshold. If a sample exceeds this threshold, it is replaced with zero.

(paragraph 0003)   The advantage being that this process provides a more reliable

detection of impulsive noise so that those samples which are affected by noise may be

blanked in order to reduce the impulsive power, reduce the effect of impulsive noise on

automatic gain control and reduce the propagation of impulse noise effects from symbol

to symbol within a demodulator of the digital type. As a result the number of symbol

errors can be substantially reduced and the reception performance of a receiver can be

substantially improved. (paragraph 0046, 0047)

4.   Arambepola fails to teach that the signal has been equalized as in the claimed

invention. However, Nielsen does teach this feature in Figures 1, 2 and 4. An adaptive

equalizer receives the signal from the A/D converter, and equalizes it. (Column1 lines

60-62) Equalizers are well known in the art. Adaptive equalizers for digital signals are

relatively new and generally include a multi tapped digital filter through which the signal

is passed. The filter taps are periodically updated and based on error signals that are

developed by comparing the received input signal with a known training sequence (or

other known signal). (Column 1 lines 14-22)   The advantage being that an improved

adaptive equalizer for a digital signal is provided that compensates for impulse noise in

the received signal. (Column 1 lines 32-36)

5.   Therefore, taking the combined teaching of Arambepola and Nielsen as a whole,

it would have been obvious to one of ordinary skill in the art at the time of the invention

to modify the method for reducing impulse noise as taught by Arambepola with the

method of reducing impulse noise applied to an equalized signal as taught by Nielsen

as in the claimed invention. Thus, the entire system would reduce noise energy and

propagation effects and substantially reduce symbol-to-symbol noise resulting from

impulsive noise. (Arambepola Abstract) Also, an improved adaptive equalizer for a

digital signal is provided that compensates for impulse noise in the received signal.

(Nielsen Column 1 lines 32-36)

6.   Regarding claims 2 and 21, refer to the combined teaching above. Note also that

Arambepola teaches the MCM signal is an OFDM signal in paragraph 0020.

7.   Regarding claims 3 and 22, refer to the combined teaching above. Note also that

Arambepola teaches this feature in Figure 3. The transfer function is the LaPlace or

Fourier transform of the impulse response function.

8.   Regarding claims 4 and 23, refer to the combined teaching above. Also note that

Arambepola teaches this feature in Figure 3 and paragraph 0074.

9.   Claims 5 and 24 rejected under 35 U.S.C. 103(a) as being unpatentable over the

combined teaching and in view of Stopler et al US Patent 6920194 B2

10.   Regarding claims 5 and 24, the combined teaching of Arambepola and Nielsen

fails to teach that the removing step removes the portion by taking the matrix product of

the estimated impulse noise as in the claimed invention. However, Stopler does teach

this feature in Figure 3. According to Stopler et al Figure 3 , the output of FIFO 40 can

be reused for impulse waveform estimation. This is done by multiplying the output of

FIFO 40 by matrix $(F'F)^{-1}$, a L*L matrix, with the product being the impulse waveform

estimation. (Column 24 lines 33-36) The advantage being that this system a robust and efficient impulse detection system which can adequately detect impulses, which have two or more unknown (or varying) degrees of freedom. (Column 2 lines 67- Column 3 line 21)

11. Therefore, taking the combined teaching and Stopler as a whole, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined teaching to include the removing step removing the portion by taking the matrix product of the estimated impulse noise as taught by Stopler. In so doing the entire system provides an improved technique for detecting and timing impulses which have attributes that span a number of degrees of freedom; the system will also reliably detect an impulse, determine its attributes, and then take appropriate corrective action. (Column 3 lines 10-15)

12. Regarding claims 6 and 25, refer to the combined teaching above. Also note that Arambepola teaches that at least part of the removing step takes place in a frequency domain in Figure 3 and paragraph 0074.

13. Regarding claims 7 and 26 refer to the combined teaching above. Note also, that Stopler teaches subtracting approximated impulse noise from the received signal to form a compensated version of the received-signal. (Column 2 lines 31-33, Column 5 lines 33-41)

14. Claims 8 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over the combined teaching of Arambepola, Nielsen and Stopler in view of Belotserkovsky EP 1178642 A2.

15.   Regarding claims 8 and 27, the combined teaching above fails to teach taking

the fast Fourier transform (FFT) of the time-domain compensated received-signal to

produce a frequency-domain version of the compensated received-signal as in the

claimed invention.   However, Belotserkovsky does teach this feature in Figure 4;

Column 5 lines 33-46) Belotserkovsky goes on to teach taking the product of the

frequency-domain version of the compensated received s-signal and an inverse (H^{-1}) of

H.(Column 6 lines 5-16)

16.   Regarding claim 9, refer to the combined teaching above wherein Arambepola

teaches approximating total noise in the equalized signal (paragraph 0011).

Arambepola also teaches approximating the impulse noise based upon the

approximated total noise (paragraphs 0013, 0027).

17.   Regarding claims 10 and 28, refer to the combined teaching above wherein

Arambepola discloses at least part of the step of approximating the impulse noise

(paragraph 0011) takes place in a time domain (Figure 3, paragraph 0074).

18.   Claim 11 rejected under 35 U.S.C. 103(a) as being unpatentable over the

combined teaching as applied to claim 1 above, and further in view of Belotserkovsky et

al EP 1178642 A2

19.   Regarding claims 11 and 29, the combined teaching fails to disclose use of peak-

detection to produce a time-domain version of the estimated impulse noise as in the

claimed invention. However, Belotserkovsky et al does teach this feature in Figures 4

and 5.   Belotserkovsky also teaches impulse noise based upon a time-domain version

of the approximated total noise in Figure 4, (see also paragraphs 0015, 0023 and 0024)

The advantage being that the OFDM receiver filters the FFT retransformed OFDM

signal to remove additive channel noise and increase the likelihood of reliable equalizer

tap initialization in a low SNR environment. (Column 8 lines14-18) Therefore, taking the

combined teaching and Belotserkovsky as a whole, it would have been obvious to one

of ordinary skill in the art at the time of the invention to modify the combined teaching to

include the peak detection method as taught by Belotserkovsky as in the claimed

invention. In so doing, the entire system provides an OFDM receiver filters the FFT

retransformed OFDM signal to remove additive channel noise and increase the

likelihood of reliable equalizer tap initialization in a low SNR environment. (Column 8

lines14-18)

20.   Regarding claims 12 and 30, refer to the combined teaching above wherein

Arambepola discloses at least part of the step of approximating the total noise takes

place in a frequency domain (Figure 3 paragraph 0074).

21.   Claims 13 and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable

over the combined teaching of Arambepola, Nielsen, and Stopler in view of an IEEE

article entitled Equalization of OFDM-Systems by interference Cancellation Techniques

by Martin Toeltsch and Andreas Molisch

22.   Regarding claims 13 and 31, the combined teaching of Arambepola, Nielsen and

Stopler discloses estimating a baseband signal that includes a set of transmitted

symbols (Arambepola paragraphs 0015-0021). The combined teaching further

discloses, subtracting the estimated baseband signal from the equalized signal to form

a set of differences (Stopler, Column 3 lines 40-46) The benefit being that this provides

a method for compensating for strong impulse interference in a multi-carrier system. (Stopler column 3 lines 6-7) The combined teaching fails to disclose multiplying the set of differences by an estimated channel transfer function (**H**) as in the claimed invention. However, Toeltsch et al does teach this feature in the IEEE article referenced above, wherein Section III Channel interference Matrix describes an equation to multiply the set of differences by an estimated channel transfer function in equation 3. (page 1951 paragraphs 1-3) The benefit being that interference cancellation has mainly been investigated in the context of CDMA systems however the techniques proposed by this method can be applied to the OFDM equalization problem. (page 1950 paragraph 4) Therefore taking the combined teaching and Toeltsch et al as a whole, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the combined teaching to include the method of multiplying the set of differences by an estimated channel transfer function as taught byToeltsch. Doing so provides a method for compensating for strong impulse interference in a multi-carrier system. (Stopler column 3 lines 6-7) and interference cancellation has mainly been investigated in the context of CDMA systems however the techniques proposed by this method can be applied to the OFDM equalization problem. (page 1950 paragraph 4)

23.   Regarding claims 14 and 32 refer to the combined teaching above wherein Arambepola discloses at least part of the step of approximating the total noise takes place in a time domain (Figure 3 paragraph 0074).

24.   Claims 15 and 33 rejected under 35 U.S.C. 103(a) as being unpatentable over the combined teaching as applied to claim 11 above, and further in view of Richards et

al US PG Publication 2002/0061081 A1 and further in view of Belotserkovsky et al EP
1178642 A2.

25.   Regarding claims 15 and 33, the combined teaching fails to disclose estimating a
baseband signal that includes a set of transmitted symbols as claimed. However,
Richards et al does teach this feature in Figures 15, 16, 23 and 24. According to
Richards, a data sample is combined with a plurality of nulling samples to produce an
adjusted sample. A method of reducing interference involves sampling potential
interference in a received signal at a plurality of sampling times near an expected time
of arrival of an impulse in an impulse signal (also included in the received signal), to
produce a corresponding plurality of interference nulling samples. (paragraph 0025)
The received signal includes the set of transmitted symbols. The advantage being that
by reducing interference in an impulse radio receiver, improved signal-to-interference
level in the impulse radio is provided. (paragraph 0021) Therefore, taking the combined
teaching and Richards as a whole, it would have been obvious to one of ordinary skill in
the art at the time of the invention to modify the combined teaching to include estimating
the baseband signal that includes a set of transmitted symbols as taught by Richards.
Thus, the entire system would reduce interference in an impulse radio without
substantially increasing hardware or power requirements in the impulse radio.
(paragraph 22)

26.   The combined teaching fails to teach that taking the inverse fast Fourier
transform (IFFT) of the frequency-domain product to form a time-domain version of the
product as claimed. However, Belotserkovsky et al does teach this aspect in Figures 4

and 5. According to Belotserkovsky, The channel estimate is passed to an IFFT unit

that applies an inverse Fast Fourier Transform such that the frequency-domain channel

estimate is transformed into a time-domain channel estimate. (Column 4 lines 31-36)

The advantage being that the OFDM receiver preferably filters the fast Fourier

transformed OFDM signal to remove additive channel noise and increase the likelihood

of reliable equalizer tap initialization in a low SNR environment. (Column 8 lines 13-17)

Therefore, taking the combined teaching and Belotserkovsky et al as a whole it would

have been obvious to one of ordinary skill in the art to modify the combined teaching as

taught by Arambepola and Nielsen to include the symbol timing recovery in a multi-

carrier receiver as taught by Belotserkovsky as claimed. In so doing, the entire system

provides an OFDM receiver preferably filters the fast Fourier transformed OFDM signal

to remove additive channel noise and increase the likelihood of reliable equalizer tap

initialization in a low SNR environment. (Column 8 lines 13-17)

27.   Claims 16 and 35 rejected under 35 U.S.C. 103(a) as being unpatentable over

the combined teaching of Arambepola, Nielsen, Stopler and Belotserkovsky in view of

Frank et al US PG Publication 2003/0035469 A1.

28.   Regarding claims 16, 35 and 41, in the combined teaching, Arambepola teaches

the estimating step and the removing step can be performed iteratively (paragraph

0004, 0011, 0012). While Belotserkovsky teaches a first such iteration resulting in a

first noise-reduced version of the equalized signal (Figure 5, Column 4 lines 5-10) The

advantage being that the OFDM receiver preferably filters the fast Fourier transformed

OFDM signal to remove additive channel noise and increase the likelihood of reliable

equalizer tap initialization in a low SNR environment. (Column 8 lines 13-17) The

combined teaching fails to disclose making a second iteration of the estimating step and

the removing step in which the estimating step operated upon the first noise-reduced

version of the equalized signal. However Frank et al does teach this feature in

paragraphs 0017 and 0052. One of ordinary skill in the art would understand that Frank

teaches that the second iteration producing a second noise-reduced version of the

equalized signal which has a lower noise content than the first version is inherent,

based on the fact that the second iteration is performed on the first version. The

advantage being that these iterations may be used until a desired level of accuracy is

achieved. (paragraph 0010) Therefore, taking the combined teaching and Frank as a

whole, it would have been obvious to one of ordinary skill in the art at the time of the

invention to modify the combined teaching to include the iterations as taught by Frank

and in so doing the entire system provides iterations that may be used until a desired

level of accuracy is achieved. (paragraph 0010)

29.   Regarding claims 17, 37, 38 and 42; refer to the combined teaching above

wherein Frank teaches this feature.

30.   Claim 18 rejected under 35 U.S.C. 103(a) as being unpatentable over Nokes et

al EP 1043874 A2 in view of Greenwood et al EP 1011235 A2.

31.   Regarding claim 18, Nokes teaches clipping, prior to equalizing the MCM signal,

peaks above a threshold in Figure 1. (Column 3 lines 44 – Column 4 line) The

advantage is that the OFDM demodulator itself is able to withstand a higher level of

impulsive interference. (Column 2 lines 6-8)

32.   Nokes fails to teach that the equalized signal is an equalized version of the

clipped MCM signal as in the claimed invention. However, Greenwood does teach this

feature. (see Column 3 lines 28-46) The advantage being that this prevents the

majority of the impulse power spreading across the OFDM frequency cells. (Column 3

lines 47-48) Therefore, it would have been obvious to one of ordinary skill in the art at

the time of the invention to modify the detection and removal of clipping in multi-carrier

receivers as taught by Nokes to include the equalized version of the clipped MCM signal

as taught by Greenwood. Doing so provides a system in which the majority of the

impulse power spreading across the OFDM frequency cells. (Column 3 lines 47-48).

33.   Regarding claim 19, refer to the combined teaching above wherein Nokes

discloses the clipping step clips the MCM signal to either a threshold level or to zero.

(Abstract)

34.   Regarding claim 39, refer to the combined teaching that applies the teaching of

Arambepola, Nielsen, Stopler and Belotserkovsky. Belotserkovsky teaches the

apparatus comprises a first fast Fourier transformer (FFT) to provide a frequency-

domain version of the received signal to the equalizer in Figures 4. Belotserkovsky also

teaches the impulse-noise estimator includes an inverse FFT (IFFT) and a second FFT

in Figure 4. Belotserkovsky further teaches the IFFT providing a time-domain version of

the total noise in Figure 4. Moreover, Belotserkovsky teaches the impulse-noise

estimator being operable to provide a time-domain estimate of the impulse noise based

upon the time-domain estimated total noise. (Column 4 lines 36-43) Also, note that

Belotserkovsky teaches that the second FFT being operable to provide a frequency-domain version of the estimated impulse noise. (Column 4 lines 20-25)

35.   Claims 43 and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Infineon WO 00/52892 A1 in view of Reuven US Patent 6047022.

36.   With respect to claims 43 and 44, Infineon discloses a system in Figure 1 wherein an analog to digital converter (1) to digitize the output of the down-converter; a guard-interval removing unit (2) operable upon the digitized output of the down-converter; a combined FFT (9), equalization (11) and impulse-noise-compensation unit (3) operable upon a signal from the guard-interval-removing unit. According to the figure, impulse noise cancellation can be performed at various points (8, 10, or 12) in the signal processing chain. Due to the Fourier transform and equalization steps being *after* the guard interval removal (Cyclic Prefix) step 2; it is accepted that the impulse noise estimate comes from the input to the impulse noise compensation unit, one of ordinary skill understands that the removal is still performed on the output, unit which in turn qualifies it as being *operable* on the output. The benefit being that an improved method of canceling noise is calculated. (Abstract)

37.   Infineon fails to teach a down converter as part of the apparatus as in the claimed invention. However, Reuven does teach this feature in Figure 5A. The benefit being that an apparatus for transmission of high-speed data over communication channels is provided. (Column 2 lines 15-18) Therefore, taking the combined teaching of Infineon and Rueven as a whole, it would have been obvious to one of ordinary skill in the art at the time of the invention to modify the noise cancellation method as taught

by Infineon to include the down-converter as taught by Reuven. Thus the entire system

would provide an improved method of canceling noise. (Infineon Abstract)

38.   Regarding claim 45, which corresponds to claim 2, has been rejected based on

the combined teaching above.

39.   With respect to claim 46 corresponds to claims 1 and 20; has been rejected

based on the combined teaching above.

40.   Regarding claim 47 refer to the combined teaching above wherein

Belotserkovsky teaches the removing step produces a time-domain compensated signal

(Column 5 lines 33-38) and further discloses equalizing a frequency-domain version of

the compensated signal (Column 5 lines 39-57).

41.   Regarding claim 48 refer to the combined teaching above wherein

Belotserkovsky teaches this feature in Figure 5 .

Allowable Subject Matter

42.   Claim 40 objected to as being dependent upon a rejected base claim, but would

be allowable if rewritten in independent form including all of the limitations of the base

claim and any intervening claims.

43.   The following is a statement of reasons for the indication of allowable subject

matter: The prior art does not teach or moderately suggest wherein an apparatus is

configured such that the impulse noise estimator and noise compensator are connected

to the fast Fourier transformer in a way that three separate layout connections are

formed with the equalizer and inverse fast Fourier transformer.

Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Sonia J. King whose telephone number is 571-270-1307. The examiner can normally be reached on Mon-Fri 7:30am-5pm alt Fri's off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mohammed Ghayour can be reached on 571-272-3021. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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SUPERVISORY PATENT EXAMINER